The Problem of Pain In Nature

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THE PROBLEM OF PAIN IN NATURE

C.F.Newall

THE PROBLEM OF PAIN IN NATURE

WITH SEVEN ILLUSTRATIONS

BY

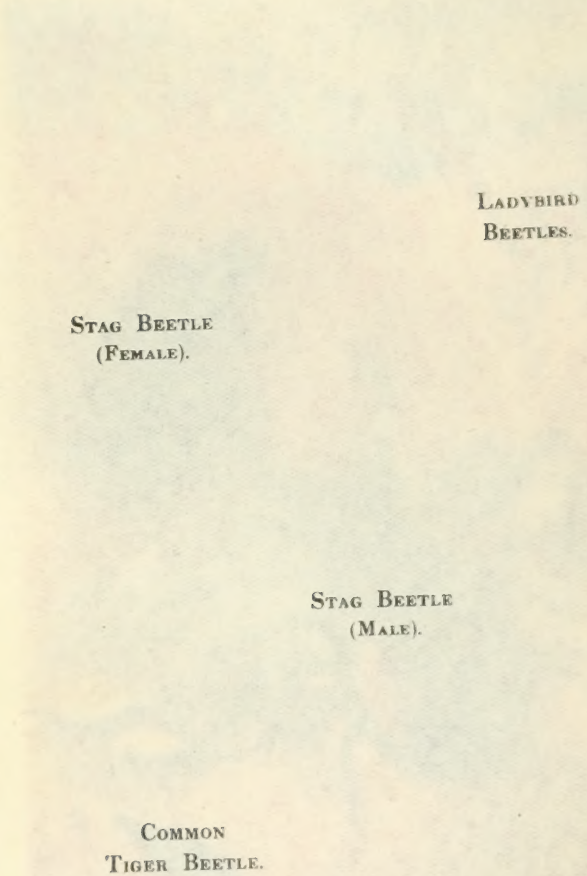
CHARLES E. NEWALL

KNOX COLLEGE

PAISLEY: ALEXANDER GARDNER

1917

PLATE I.



Ladybird
Beetles.

Stag Beetle
(Female).

Stag Beetle
(Male).

Common
Tiger Beetle.

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PREFACE.

ALMOST two years ago I had written an article on the subject of this book: its brevity, however, did not allow of adequate treatment at all, and it was not printed. The Rev. Charles A. Hall, F.R.M.S., suggested that it should be written in extended form, and the present little volume is the fruit of that suggestion.

I trust the drawings I have produced for this little work may be found helpful, and convey to the reader a better realisation than mere descriptions can usually do.

I have to thank Mr. Hall, also, for his kind revision of the proofs.

C. F. NEWALL.

WALLASY,
CHESHIRE,
September, 1916.

FOREWORD.

THE problem of Pain in Nature, although commonly ignored by the "crowd," has always troubled the thoughtful and benevolent observer. The fact of Nature being "red in tooth and claw" suggests a lack of beneficence in the general scheme of things. It is asked, Where do kindness and mercy come in, in the seemingly cruel and relentless struggle for existence? Do the victims of that struggle suffer as they seem to suffer in the eyes of human beings; have they that consciousness of pain, and anticipation of disaster, that we possess? Any thoughtful contribution to a solution of the problem should be welcomed, and Mr. Newall's essay is worthy of a careful reading.

C. A. H.

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"On the whole the popular idea of the struggle for existence entailing misery and pain in the animal world is the very reverse of the truth. What it really brings about is the maximum of life, and the enjoyment of life, with the minimum of suffering and pain. Given the necessity of death and reproduction—and without these there would have been no progressive development of the organic world—and it is difficult to imagine even a system by which a greater balance of happiness could have been secured."

ALFRED RUSSELL WALLACE (*Darwinism*).

THE PROBLEM OF PAIN IN NATURE.

CHAPTER I.

THE PROBLEM STATED.

THOUGH this problem has faced men, Sphinx-like, in all ages, it is safe to say that its implications are much more acutely felt and realised to-day than they have ever been in the past.

There are many reasons why it should be so. The more widespread results of education have enabled men to think more fully and accurately for themselves; later biological research has amazingly increased our knowledge of the facts of Natural life;

while there have been evolved a keener sensitiveness, a deeper humanitarianism, a nobler "pity of sorrows" in the thoughts of men, however tardy this advance has been as yet in dealing practically with the *causes* of human suffering and pain.

And that keener realisation has brought with it to thousands no little mental and heartfelt pain and doubt; it has done much, in many minds, to stultify acceptance of Christian interpretations, and to make possible a loose and widespread acceptance of such materialistic and really unscientific theories of Life as that of Haeckel's *Riddle of the Universe.*

The futility and self-contradiction of the *theories* built up by this great biologist, respecting the origin and essential nature of Life have been clearly pointed out by Wallace,[1] Sir Oliver Lodge,[2] and others.

[1] *The World of Life* (chap. i.), Alfred Russel Wallace, F.R.S., etc.

[2] *Life and Matter*, Sir O. Lodge, D.Sc., F.R.S.

There are no real grounds for the entirely dogmatic assertions of Haeckel in the book mentioned—for this deification of matter; it seems a pity that such an authority upon the actual *facts* of biology, should have attempted to solve the Riddle of the Universe—without God!

It is strange that so little definite and systematic enquiry seems to have been made into the problem before us by biologists, or even philosophers. At any rate there does not appear to be any connected information, in popular form, on the subject generally.

I have omitted all but some casual reference to pain as known in human life, as, of course, where moral choice is possible, and where beneficent natural laws can be and are regularly defied and scorned, the conditions are radically altered; also the experience of pain in this sphere doubtless serves profounder and higher purposes, and in this aspect has been frequently discussed.

It may be said that if we could show

substantial cause for the belief that the amount of pain animals are capable of suffering is nothing like that which it is usually supposed to be, that such creatures would be treated with less consideration, and that "cruelty" would be more common. I do not believe this would be so, to-day. A merciless man has always been merciless to his beast, and all beasts—*whatever theories* about pain might be held—and he always will be. But one is glad to think that, in relation to all lower animals, the merciless man is by no means so frequently to be found now in civilised communities;[1] and that greater sensitiveness that has felt the apparent "cruelty" of Nature, in later years, so keenly that it has not seldom formed an impassable barrier to faith in God, carries with it largely the guarantee that definite cruelty by man will not be lightly tolerated.

It is not necessary, in our time, to enlarge

[1] I have not overlooked Vivisection, though it may seem so.

upon the fact of Nature being "red in tooth and claw," upon the universal sweep of the predatory system, with its elaborate and deadly weapons of offence and defence. But perhaps it will be well to set forth one or two representative facts, well known to biologists, which will serve to show that, regarded from a superficial standpoint, and approached with that common anthropomorphic estimate of *all* life from which it is so difficult for us to free ourselves, we should certainly suppose pain to be suffered by the victims to which we shall refer.

With a very wide distribution in most countries we find a great number of species of powerful wasps, known as "Mud-Wasps" and "Sand-Wasps." (Plate III., 4.) These build nests of clay, or make burrows in the sand, and, the operation being completed, range abroad in search of food with which to stock them for the benefit of their young. That food consists of spiders, caterpillars, or other insects which the wasps proceed to

paralyse by a sting deftly inserted into the body where the main nervous centres are grouped. Such victims are borne to the nest, and upon them the wasp's egg is deposited. Upon emerging from the egg the larva proceeds to feed leisurely upon the living bodies of the helpless caterpillars, etc., till it assumes the chrysalis stage.

Again, there are thousands of species of Ichneumon-fly (Plate III., 5), distributed widely—almost universally—which invariably lay their eggs in, or upon, the bodies of other insects, the larvæ from which feed continuously upon the living tissues of the body of their host, avoiding in some mysterious way the destruction of vital parts till all else is consumed. The victim continues to live and eat, and may even pass into another stage, but death, as a result, is shortly inevitable.

In winter the Mole is known to sometimes store up fresh food, for later consumption, in the shape of earthworms, decapitated

but alive. In this condition the worms are unable to travel, and cannot re-grow new heads, as *some* worms can.

Does the reader shrink from the recital of such facts? Let him meditate awhile upon the significance of that natural and instinctive recoil! Of course, facts like these represent only *one* side of the question: in any fair estimate of natural life we should have to balance against such facts a great number of others, such as those of co-operative helpfulness, and the whole series which would fall under Drummond's view of "The struggle for the life of others."[1] Yet they form a group which we are in mental and moral honesty bound to consider in any general conception we may hold of the general system of living Nature.

Certainly in this realm of Nature (apart from the case of man himself) we cannot attribute pain or suffering to "folly"—defi-

[1] *Ascent of Man.*

ance of natural law—or "sin." Here, too, the distortive influences of man have played no part.

We are now perhaps in a position to realise better the difficulty felt by thoughtful and reverent biologists when they are confronted by the Psalmist's declaration that "the Lord is *good* to all, and His *tender mercies* are over *all* His works." The statement is David's; but it appears to represent the general scriptural writer's point of view, and that proclaimed by most modern Christian thinkers, and the Churches, as voiced in the few random selections which follow—

> "If Nature is the garment of God, it is woven without seam throughout: if a revelation of God it is the same yesterday, to-day, and for ever: if the expression of His will, there is no variableness or shadow of turning."[1]

[1] Henry Drummond, F.R.S.E., F.G.S.

"I repeat as a man may of God's work,
All's love, yet all's law."[1]

"None but the fool in heart will deny that Nature witnesses for God. Rightly interpreted, she is the Garment, the Vesture we see Him by."[2]

"The great God has built up in the universe around us the deepest ideas of His own heart."[3]

"That earth which He has given to the children of men, not merely for the material wants of the body, but as a witness, and sacrament."[4]

"Nature is nothing else but a gradual disclosure of His power, His order, His beauty."[5]

The question which arises in the minds of most reverent and enquiring men is frequently of this nature—

---

[1] Robert Browning. [2] Emerson. [3] Rev. T. G. Selby.
[4] Rev. Charles Kingsley. [5] Canon Gore.

"Does that set of facts, of which I have given instances, present a fatal antagonism to the acceptance of such a general conception as is embodied in such quotations, or is there a legitimate basis of reconciliation?"

CHAPTER II.

SENSITIVENESS AND PAIN.

I PROPOSE to consider certain facts of animal organization and behaviour, and to put forward deductions, often amounting to conviction, which have been expressed in late years by those whose constant observation and study of living creatures enables them to give an expert opinion.

One difficulty commonly felt by those not especially conversant with animal physiology is that of really grasping the fact that *sensitiveness* to stimulation does not necessarily involve the *capacity to feel pain*. Yet to try and realise the distinction which exists between sensitiveness and pain is important in the consideration of this problem.

J. G. Wood, M.A., F.L.S., whose first-hand acquaintance with such creatures was

very close, states that a bat, deeply sunk in the unconscious state of hybernation, will wriggle if merely touched, without awakening—a state of reflex sensitiveness in this way even more marked than in the conscious and active condition.

Now we find this sensitiveness, resulting in responsive movement and action, well displayed in even the most primitive single-celled animal organisms (Plate III., 1, 2, 3) —mere microscopic specks of apparently undifferentiated protoplasm—in the entire absence of anything we can suppose to be "nervous" matter. It may be pretty confidently asserted that biologists are agreed that in such lowly organised creatures—some are certainly both plant and animal—there can exist no capacity for the experience of pain in any degree. The number of species which may be safely included is legion.

But if the lowliest forms of animal life possess this "nervous" power of sensitiveness and response to outside stimulus, it is

now certain that *plants* also are possessed of nervous sensation, and frequently respond more rapidly and actively than many lower forms of animal life appear to do. Not only is this the case with the "highly-strung" Sensitive Plant, or the Telegraph Plant—whose smaller leaves are in constant rhythmic motion—but with that also of the commonplace Radish! No nervous organisation can be detected, but the marvellous experiments and revelations made by Prof. J. C. Bose during the last few years may be considered conclusive. It is found that anæsthetics, alcohol, poisons, and electric currents have the same fundamental effect upon the living plant as they have upon the living animal: and it is now, for many other reasons beside these, an axiom of modern biological science that nervous action and reaction is an inherent property of all protoplasm, or living matter, as such.

The coordinated and purposive actions of the insectivorous plants (Sundews, "Venus

Fly-trap," Pitcher plants, etc.) when an insect is caught and digested are well known. Watching a Sundew plant on such an occasion gives one almost an uncanny feeling—as if one were observing results of conscious and intelligent action.

If it is assumed for a moment that because an organism is alive, and gives evidence of nervous response to various stimuli from its environment, it is therefore necessarily capable of sensations of pain, then we inflict suffering on every poor radish we eat, and "are guilty," as Prof. Romanes graphically put it, "of the horrible cruelty of skinning potatoes, and boiling them alive!"

It is well known to all medical doctors and physiologists that if a man's spinal cord be seriously injured, so that communication between the lower part of the body and the brain be cut off, there is then no power of conscious movement in the lower limbs, and no sensation felt if they are pinched or pricked.

No *conscious* movement—but let the feet be irritated, and they will quickly and naturally be withdrawn from the source of disturbance, quite apart from will or consciousness on their owner's part.

In just the same way a decapitated frog will strive to wipe away with one leg a drop of acid placed on the other, using its muscles as if in quite normal condition; it will preserve its balance on the moving hand, and so forth, in a manner decidedly disconcerting to the unitiated. Any capacity for *conscious* action has, of course, disappeared with head and brain.

What does this mean? The explanation is comparatively simple, and is of vast importance in our present review.

The fact is that though the spinal cord functions mainly as a telephonic connection between the outside of the body, where stimuli are received, and the brain, where messages flashed along the nerves become *conscious sensations*—it may be of pain—it is

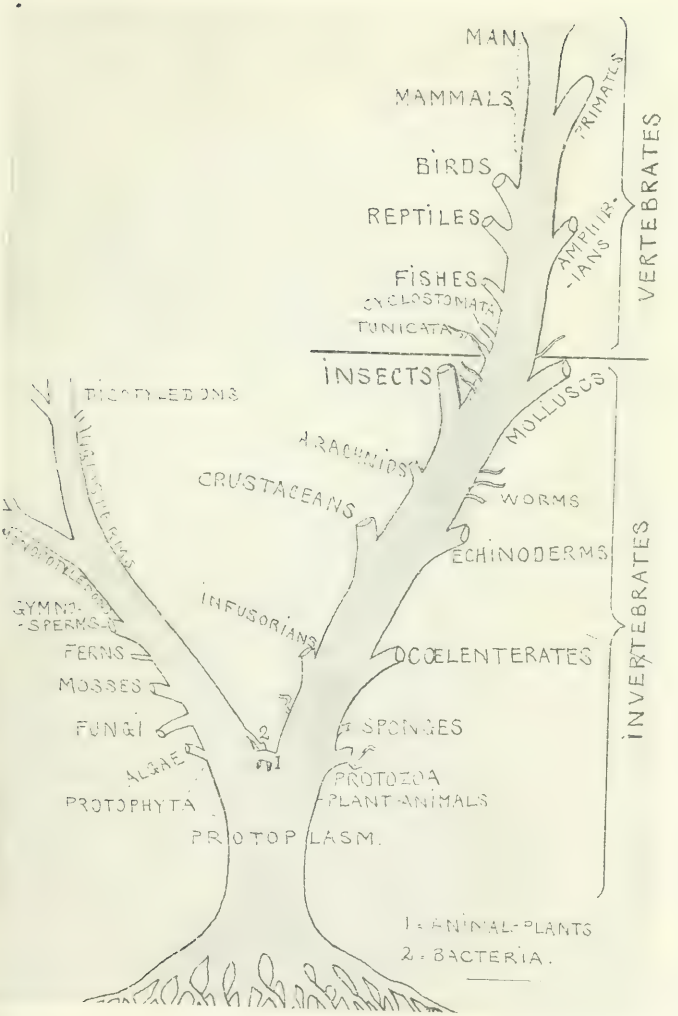
also in itself an independent nerve-centre, and in many cases does not transmit sensory impressions to the main centre, but acts apart from any brain consciousness. Such impressions may result in responsive motor-impulses being conveyed to the muscles by the action of the spinal cord, of which we have no consciousness at all.

In the fearful and wonderful economy of our own bodies, many of the most fundamental and important functions are carried on in this way. The constant movements concerned in respiration, the ceaseless beating of the heart, the circulation of the blood, the elaborate processes of digestion, and the regular motion of cilia lining various membranes, may be taken as instances.

Now this is what is really meant by "reflex action"—words familiar to almost everybody, but the significance of which seems by no means understood by everybody.

The common earthworm has no special

PLATE II.



Diagrammatic "Tree-of-Life."

organs of sense, and *no brain.* It is undoubtedly sensitive to touch, but we have every reason to believe that its wrigglings when injured by the spade, etc., are purely reflex in character, like the activity of the legs of a headless frog.

It may come as a surprise to many to know that, if we accept the expressed opinions and convictions of many prominent naturalists, we have no little reason to believe that in the category of living creatures incapable, or practically so, of sensation of pain, we must include, beside plants and protozoa, the whole vast series of invertebrate animals! A reference to the diagram representing the evolutionary "tree of life" will show more effectively than any mere list what groups of animal organisms are comprised in this division. (Plate II.)

As far as evidence goes at present it seems that consciousness only results when a nerve-centre attains to such complex and delicate development as we find in what can

properly be called a "brain"; and in following up the ascent of the invertebrate animals we shall first meet, perhaps, with an approach to a brain in the highest group of the Molluscs — the Cuttles — while the cephalic ganglia of some of the highest insects, in the adult form, may be admitted as constituting an elementary brain: in the ants a true brain, where it has reached an almost startling development! But here we have reached the uppermost limits of the Invertebrates!

As to the witness of experts, Wallace includes in a list of probably "painless animals" all aquatic animals up to fishes, all insects, and all molluscs and worms. This category virtually includes all Invertebrates.

Mr. H. W. Shepheard-Watwyn, M.A., F.Z.S., F.R.S., thus expresses his own view:—

> "It is my sincere belief that the Creator has *purposely* arranged that the lowest forms of animals" — he has just been

speaking of insects, earthworms, and other small fry — "which would naturally be most frequently destroyed or maimed, should experience practically no suffering during the process, by omitting from their composition the power of feeling any real sense of pain, *and I could name more than one eminent scientist who shares this opinion.*"[1]

Apart from such expressions of belief, there is a natural process which takes place frequently during the growth of all crustaceans—crabs, lobsters, shrimps, etc.—the periodic casting of the crust or "shell." The latter, once formed, does not increase in size, so that as the creature grows it soon becomes a decidedly tight fit. A lobster may moult as many as twenty times.

It is always a matter of some difficulty: and though a wonderful provision is made to facilitate escape from the old crust, the fleshy parts becoming soft and watery, and

[1] The italics are mine.—C. F. N.

the water and blood being withdrawn from the claws when these are being pulled through the small and sharp-edged apertures at the joints, still we should certainly think that the operation *must* be painful, if such creatures are susceptible of pain.

The drastic nature of such periodic moults may be better realised when we remember that many infoldings of the "skin"—such as the membranous coverings of the gills, and the lining of the stomach—are removed along with the outer crust. There is no doubt that the process is exhausting, as it appears to be also in the very similar moulting of spiders and larval insects.

The Rev. Theo. Wood, F.E.S., indeed states that the flesh of the great claws of crabs is sometimes cut into ribbons by the keen edges of the tendinous plate to which it is ordinarily attached; but there does not appear to be any confirmation of such "ruthless surgery."

But when we have the report before us of

Mr. Rymer Jones, who watched one of our common shore-crabs "while eating another, itself being seized by a larger crab and eaten in his turn"; when Mr. Jones adds that "he did not seem to be sensible of the fact, but went on eating till he was entirely crushed," Mr. Wood's further statement does not seem at all incredible :—

> "As a matter of fact, however, crabs do not appear to be in any way susceptible to suffering. This is not an inference from their organisation—sensory nerves, as apart from those that act upon the muscles, being practically wanting; it is an obvious deduction from undeniable facts."

And if so, *why* should crabs and other crustaceans be particularly blest in exemption from pain, more than other allied creatures?

CHAPTER III.

THE CASE OF THE INSECT.

A SPECIAL consideration of the position of Insects in relation to this problem is important, as many far-reaching deductions become weighty if we have cause to believe that capacity for pain is not present in insect life.

That no such capacity exists among the creatures of this vast class—Insecta—is a matter of very general belief among entomologists and naturalists generally—a belief in no wise originating in fancy, sentiment, or the wish that it should be so (and, as we shall see, one may well *hope* that it is so), but as a plain inference from the constantly observed facts of insect life.

Besides the opinion of Wallace and others mentioned, and the implications arising from

Romane's considerations, many statements of the kind could be quoted. The Rev. J. G. Wood, M.A., F.L.S., a keen observer and practical entomologist, a man peculiarly sensitive to pain himself, and shrinking from its infliction, makes many such declarations; while Mr. Harold Bastin, in a volume lately published,[1] writes as follows:—

> "Yet while insects are keenly alive to the contact of foreign bodies, they seem for some inscrutable reason (!) to be completely immune from the sensation of pain. It is possible to pass a pin through the body of a sleeping moth without awakening it. . . . Still more remarkable is the case of a Dragon-fly, mentioned by the Rev. Theo. Wood, which by an unlucky chance had been deprived of its abdomen. This insect not only devoured some thirty Bluebottle flies, but finally disposed of its own severed body in the same way. Hundreds of similar instances

[1] *Insects: their Life and Habits.* 1914.

might be cited to prove the complete 'sang-froid' evinced by mutilated insects. Possibly the loss of certain organs or appendages may give rise to a sensation of discomfort or inconvenience, but there is no clear evidence to support the contention."

What is it in connection with the life of insects, in comparison with that of other animal groups, which makes a somewhat special consideration of their history and structure of any special importance here? There are a number of such points which we will refer to.

First, in number of species and individuals, insects probably exceed those of all other classes put together; not only so, but they form an almost *universal* "food-supply" for hosts of insectivorous plants—spiders, amphibians, reptiles, birds, and mammals—not to speak of the large number of carnivorous species of their own kind. They are particularly liable to be subjected to what

would appear to us to be a slow and horrible death.

I have already referred to the victims of the Sand-Wasps or "Mud-Wasps," and of the Ichneumon-flies. As to the latter, collectors of Lepidoptera, who frequently rear their specimens up from the larvæ, have again and again expressed their belief that these infected caterpillars do not suffer pain. As a matter of fact (and I have "reared up" many moths from the larval stage myself—some infected in the latter stage), it is usually impossible to tell if such are "stung" or not till they attain full growth, unless the tell-tale black spot, caused by the ovipositor of the fly, can be seen on the skin. They not only eat freely, but move about as usual, and regularly cast their skin; there is nothing in their action or general behaviour to suggest their real condition. Now, in the rapid growth of caterpillars an increasing store of fatty tissue is formed, designed for use in the formation eventually of the perfect

moth. It is very probable that the infecting grubs feed largely on this stored tissue; even the nerves themselves can hardly be interfered with, as the caterpillar appears to be capable of the usual responses and movements till near the end.

One has only to think of the fate of so many insects seized, or pulled to pieces by Dragon-flies, the larvæ of water beetles, etc., or those that find themselves, bound and helpless, at the "mercy" of spiders—though it is well to remember that the bite of most spiders conveys poison, often virulent and speedily fatal—to realise the position.

Despite the marvellous first line of protection afforded by exquisite harmonisation with their natural surroundings, of "Warning Colouration,[1] and "Mimicry," etc., insects

[1] The Ladybird beetles are brilliantly or conspicuously coloured, and do not attempt to hide on the brightest day. They do not seem to be attacked by predacious insects, reptiles, or birds. When touched they emit a pungent and evil-smelling oily liquid, which probably makes them nauseous as food. (See Frontispiece.)

are usually helpless when once discovered and seized. Even the powerful stings of bees and wasps do not prevent their falling victims to frogs and toads, which "care for none of these things" (significant as to *their* comparative immunity from pain, for such insects are not even crushed by the teeth, and must surely use their weapons), just as the shells of snails fail to protect them from thrushes and some other birds. The Aphides, or "green flies," are perfectly helpless to resist being sucked dry by the voracious larvæ of Syrphus, and Lacewing flies, or those of the Ladybird beetles; whilst it must also be admitted that the victims of the fierce Tiger beetles (Frontispiece), and many others of carnivorous habits, are devoured slowly and piecemeal!

It is scarcely correct perhaps to say that death in this kind is *peculiar* to insects, among the Invertebrates. It must frequently be the lot of many Crustacenus, of many Molluscs (shell-fish, snails, slugs, etc.), and

most of the great assemblage of "worms." Yet in the first and last of these groups considerable powers of "Autotomy" are possessed—the capacity of instantly throwing off limbs and various parts of the body attacked—together with considerable powers of regeneration, or renewal of the lost parts; many Molluscs, besides the partial protection afforded by the shell, possess the capacity of regenerating lost parts; also many Cœlenterates—Sea-Anemones, Jelly-fish, Hydras, etc.—and most Echinoderms—Sea-Urchins, Sea-Cucumbers, Starfish, etc. (See Appendix A.)

All members of the Cœlenterate group are richly supplied with the minute but most elaborate and effective poisonous weapons known as "Nematocysts" or "Thread-cells," and on the whole seem singularly immune from attack in consequence. Yet, as in the case of all other organisms, there are "checks" provided against inordinate increase, and there are "Parrot-fishes" which

feed freely upon the coral polypes having acquired horny "beaks," or jaws, impervious to the coral's stinging powers. (See Plate III., 20, 21, 22.)

But insects rarely possess the power of Autotomy, and are not able to renew lost parts. If they escape, after being seized or injured (which *rarely happens*), they will shortly die as a result of such injuries.

While we are considering this matter of slow and piecemeal consumption, we should recognise also the fact of its occurrence in other groups.

Molluscs or "Shell-fish" with bivalve shells, like the oyster, are, as a rule, perfectly helpless when literally under the foot of a whelk or natica. These carnivorous species are able to soften a spot upon the shell of the bivalve, and with their long tongue-ribbons, studded with minute teeth, bore a neat hole through the shell through which the substance of the unlucky inmate is absorbed. Many species have averted

this fate by forming sharp erections or formidable spines upon the surface of the valves, presenting a base upon which the soft bodies of the marauders would be hopelessly uncomfortable. But the sharp spines developed upon many shells are for the defiance of an even more determined foe—the starfish. An oyster or cockle can only keep the valves of the shell closed firmly by muscular power, which is soon exhausted; but the starfish applies to the forcing apart of the valves *hydraulic power*, the strength of which is mechanical and continuous. To such a force the muscles must yield, and then all is soon over. (Plate III., 12, 13, 14.)

We must glance for a moment at the general nervous organisation of insects. An insect's body is composed of so many segments; (ideally similar, and actually so in some worms); instead of there being a supreme nervous centre, each segment may possess its own centres of nerve matter,

known as "nerve-ganglia," connected by a double nerve-thread to each other. The important result seems to be that the various segments often maintain a partially independent power of life and energy. In the adult form of many insects, especially in those most fully advanced, we find an increasing tendency towards the concentration of the main ganglia in the thorax and head. (Plate III., 6, 7.)

Now, if a man's brain is seriously injured, or if he be decapitated, the whole body speedily dies; but the loss of its head, or considerable parts of the body, may not mean any such result in the case of the Insect, as we have seen in that of the severed Dragon-fly. Really the "life" of a decapitated insect seems to depend more than anything else upon what amount of food is necessary for the supply of energy. The mouth-parts are of course lost with the head. Moths have been known to live as long without a head as with it; but as a rule,

adult moths take little or no food in their short lives.

Mr. W. H. Hudson, C.M.Z.S., gives us a graphic instance of this kind. Passing one evening through a forest gate, he noted a large Stag-beetle (see Frontispiece), which had apparently been struck down by someone passing by. Next morning, walking by the same quiet spot, Mr. Hudson found that the beetle had evidently been devoured by a hedgehog—all that now remained of it being the horny head, wing-cases, and legs, which are always rejected.

> "On looking closely," he says, "I found that the head was still alive; at a touch the antennæ . . . began to wave up and down, and the horns opened wide, like the jaws of an angry crab. On placing a finger between them they nipped as sharply as if the creature had been whole and uninjured. Yet the body had long since been devoured and digested, and there was only this fragment left, and torn off

PLATE III.

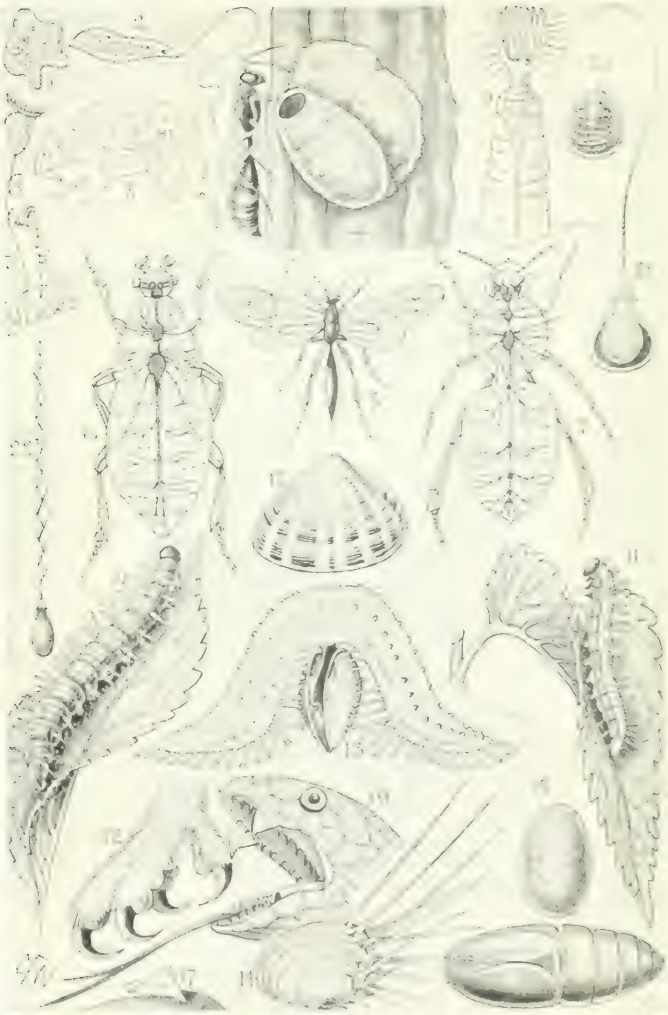


PLATE III.

1. Amœba
2. Astasia } Protozoa.
3. Vorticella
4. Mud Wasp (pelopeus) and Nest. N. America.
5. Ichneumon fly (limneria gracilis).
6. Diagram of Nervous System of Beetle.
7. Diagram of Nervous System of Bee.
8. "Water-Bear" (Macrobiotus).
9. Rotifer (stephanoceros).
10. Larva of Peacock Butterfly.
11. Larva of Comma Butterfly.
12. Bivalve shell (Mactra).
13. Starfish, opening Mactra.
14. Spine-protected Bivalve.
15. Pupa of Grass Eggar Moth.
16. Pupa of Privet Hawk Moth.
17. Nudibranch (ancula cristata).
18. Foot of Owl.
19. Head of Cobra-di-Capella.
20. "Stinging-cell" of Hydra (at rest).
21. "Stinging-cell" of Hydra (exploded).
22. "Stinging-cell" of Anemone (exploded).

> with it, shall we say a fragment of intelligent life? . . . In such cases it would perhaps be better to liken life to a red glowing ember, which may be broken into pieces, and each piece still glow and burn with its own portion of the original fire."

In the face of such facts we must realise that the mutilation of an insect when attacked, or the gradual destruction of one portion after another, leaves the still uninjured parts in possession of life and energy—quite possibly in nervous connection, for a short space with the injured parts!

The question as to what *purpose* the suffering of pain could serve in all such cases is not at all an idle one, but has most practical bearings. All able biologists and evolutionists recognize a universal law which concerns us here. It is the law that no power, faculty, or capacity is given to any living creature until it is actually *necessary* to its development and well-being. Sponges, for instance, can neither "run away" or offer

armed resistance to many creatures. It is true that owing to their embedded spicules, and for other reasons, they are regarded by fishes with repugnance; but many of the Nudibranches (beautiful shell-less, little sea-slugs) are known to feed upon their tissues, yet they are helpless to resist (Plate III., 17).

In most of the *Vertebrate* animals the capacity for pain, within certain limits, is certainly present. Its purpose in their case we can clearly perceive, and shall presently refer to: just now it is only necessary, perhaps, to recollect that the covering of such creatures—the skin—is a delicate and living structure, while the chitinous armour of Insects, and the chitinous and living "crust" of Crustaceans, and shells of Molluscs, are dead, or rather non-living and insensate structures in themselves. They are protected by their "skeletons." I have laid emphasis on the case of the Insect, not only for such reasons as I have stated (those "inscrutable" reasons of Mr. Bastin!), but

also because they present the most advanced general organisation and life-energy (along with some Molluscs) to be found among invertebrate animals. If, therefore, the capacity for pain does not necessarily exist in the most highly organised group, it is hardly to be supposed that it exists in the organisms of a *lower* and more rudimentary type, or in those in which we can recognise no trace of nervous organisation at all.

To my mind the case of the Insect presents the crux of the whole problem. If, indeed, any real capability of the experience of pain throughout the serried ranks of these and the lower Invertebrates, is actually present, here alone there would be ample evidence in support of Mr. John Stuart Mill's scathing indictment of the whole predatory system, and we must really stand aghast at the sheer and designed "cruelty" of Nature.

But the absence of a true brain, and the presence of nerve-ganglia apportioned to the

various segments, or other divisions of the body, seems to point to an almost entire control of the insects' activities by reflex action ; and we have seen that this response to the most irritating stimuli, even in connection with our own elaborate nerve-system, may be painless.

CHAPTER IV.

POISON IN NATURE.

IN the economy of Nature, as we understand it, it appears essential for many plants to protect themselves against wholesale destruction by the larger animals. The depredations of plant-eating insects and such small fry do not seriously interfere, in most cases, with the plant's life and development: but for many, to be consumed in a wholesale way by grazing animals would be fatal to their survival.

The spines of the Sloe, the thorns of numerous species, the stinging hairs of the Nettles (containing formic acid), the poisonous juices of the Deadly Nightshade, etc.—while being of effect only in relation to the capability of pain in higher animals, do not deter insects from feeding upon such plants.

Spines and thorns present no obstacle to them; while the larvæ of the Peacock (Plate III., 10), Red-Admiral, Painted Lady, Map, Comma (Plate III., 11), and small Tortoise-shell Butterflies live and feed upon the stinging nettles. All these larvæ bear peculiar spinous hairs which stand out all over the body, and which may possibly serve to shield them from the action of the stinging hairs of the plant: being dead structures we should hardly expect them to be affected by the poison. However this may be, the fact remains that great companies of such larvæ feed freely upon the leaves; also the larva of at least one beetle finds sustenance on the leaves of the Deadly Nightshade.

Some remarks upon the presence and action of poisons, in plants and animals, may be useful, and cast some light on our subject.

A considerable number of plants elaborate poisons. Sometimes the whole plant is

poisonous, in other cases only certain parts are so. Almost all species of the Nightshade family share this quality—one might mention the Bittersweet, Deadly Nightshade, Black Nightshade, Henbane, and Thorn-Apple. In other families the Spurges, Foxglove, and Poppies, Hemlock, and even Celery in a natural condition. I do not know *any* living creature that will attack the "Box" (a Spurge), and none will touch the "Greasewood," common in the Colorado Desert. Plants containing morphine, strychnine, nicotine, atropine, cocain, amygdallin (from which prussic acid and tannin can be extracted), and quinine, are left severely alone by animals. Many etherial oils, of eucalyptus, mints, etc., seem to ward off the attacks of fungi and bacteria, and also to be generally repulsive to animals.

To a considerable extent it is in this way that desert plants secure protection, and guard their water stores from the attack of animals. Desperate conditions call for des-

perate methods of safeguard. Many Cacti, for instance, in addition to their fierce armature of (sometimes) three-inch spines, and barbed bristles, become quite brittle with the accumulation of oxalate of lime in or under the epidermis—a very poisonous salt. Some desert plants are too bitter to eat, others are cathartic or emetic. (Fig. 23.)

When the "Elder expedition" set out to explore the desert of Central Australia, they depended largely for success on a large number of camels brought over from Afghanistan. These animals, being quite unfamiliar with the desert plants of another Continent, frequently became ill through attempting to eat such plants, and some died quickly after eating some of the more powerfully poisonous ones. This of course is what might have been expected.

As to poisonous Snakes (Plate III., 19) there seems to be a general concensus of opinion among naturalists that in most countries there is not much mortality among

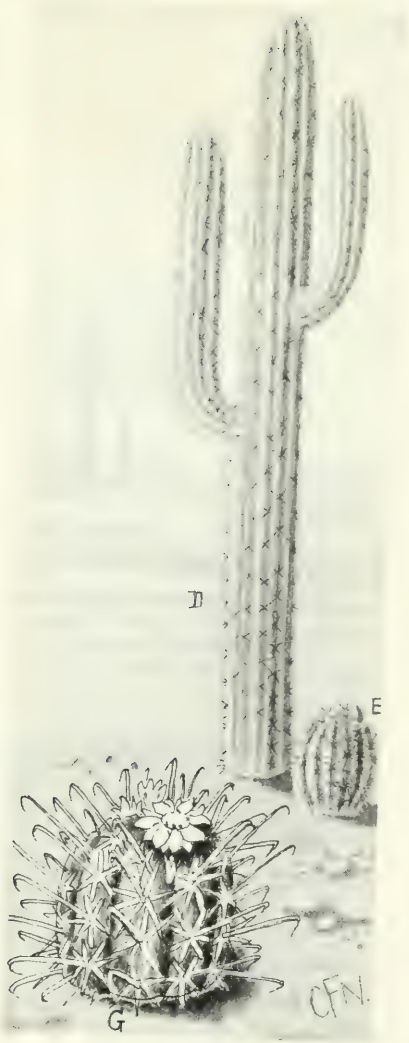


Fig. 23.—Mexican Cacti.

D.—CEREUS GIGANTICUS.
E.—MELOCACTUS COMMUNIS.
G.—ECHINOCACTUS LONGIHAMATUS.

human beings from snake bite. It is somewhat different in India; I have little doubt that the advent and spread of the bustling activities of White men, has developed an increasing irritability among the disturbed poisonous reptiles there. Natives in tropical countries are usually well acquainted with the habits of snakes—able generally even to detect a reptile's presence in spite of its protective colouration.

Neither is there a great mortality among animals through snakes! They are "the champion fasters of the world," and a single meal goes a long way. One of Dr. Stradling's boas only consumed one rabbit in the course of two years (without hybernation), though suitable food was freely offered, retaining its usual health and condition. This gentleman—an expert with regard to snakes—was of opinion that our Common Grass-Snake did well if it got six frogs in the year.

This abstemiousness, not uncommon among these reptiles, may be partly due to

the snake's poor sight. The authority quoted states that "they are probably the shortest-sighted animals in creation, no snake being capable of perceiving anything distinctly at a distance equal to twice its own length"; with which the belief of Mr. W. H. Hudson—whose observation of snakes in many countries was extensive—coincides.

Now there is little doubt that the "poison" of snakes was originally of the nature of a digestive ferment (and indeed is so still). The poison of our Common Viper dissolves albumen. Surely it is a merciful provision which also constitutes it as a swift and fatal cause of death to small animals seized? And is it merely a "coincidence" that such deadly powers are so greatly limited by the marked curtailment of the range of vision?

It would be interesting to consider the poisonous powers of Scorpions and Spiders, of many Insects and Fishes; also the effects of electric shock given out by some fifty

species of fishes. This power is exercised at will, and as I can testify from experience, even in the case of the small Electric Catfish of the Nile (Fig. 25, C), is of a strength one would little suspect. The smaller fish, used as food by the Electric Eel and Torpedo are instantly killed by the shock, whilst in other cases the discharge benumbs and paralyses.

I have referred to the helplessness of insects when caught, bound, and at the mercy of spiders. The facts given in the footnote represent many of the kind, and show clearly enough how the use of poisonous powers is not a merciless procedure, but, under the circumstances, just the opposite.[1]

[1] "The spider (one of the Eperidæ) now examines the powerless victim, and gives the fatal bite *on the hinder part of the thorax*. . . . The virulence of this poison may be judged from the fact that in half a minute I opened the mesh, and found a large wasp quite lifeless."—Darwin's *Voyages*.

"It is said that a nip from a huge 'Tarantula' (*Mygale*) would kill a man or a horse. I should think it would be very serious, at any rate, for I have seen a rat drop as though shot when pounced upon by such an enemy."—Dr. A. Stradling, C.M.Z.S.

Apart from a subtle and general suggestiveness of noxious quality often recognised by naturalists in the appearance of poisonous plants and animals, Nature has elaborated a very curious method of protecting her children from useless suffering by the institution of "Warning Colouration" and "Mimicry." No doubt the main object in such livery is the preservation of the species; but there is here also a strong suggestion that Nature *is* concerned to prevent useless pain.

Into this wide subject, again, we cannot enter here. It may be merely asked what *gain* would result, for instance, if wasps or other insects possessed of powerful stings were not easily distinguishable, but exposed to the promiscuous attack of birds, reptiles, and small mammals? The sharp pain inflicted by the swiftly-inserted sting would certainly result, in ordinary cases, in preventing any further attempt to regard such a "red-hot" sort of creature as food. The

insect itself, though it would not in my own opinion feel pain, would probably be fatally *injured* by the seizure; while only a measure of useless pain to the higher animal would result. The effects of a slight wound inflicted upon human beings by the poisonous spines of many different species of fish are often of a very painful and serious nature. Such species are almost always conspicuously coloured. Intense pain, fever, inflammation and disablement for days or weeks may result; and though such attacks are probably of a more virulent nature when acting on our more sensitive organisation, we can realise at least in this way, that the use of such powers is indeed no child's play, as wild creatures generally are well aware. These are merely typical instances, and the warning may take other forms than that of a conspicuous and brilliant colouration.

In his book, lately published, Mr. Hans Gadow makes the following statement—

"A large well-conditioned "Rattle" (of Rattlesnake) can make a shrill noise like an alarm-clock, so loud that when its owner is confined in a room, it makes conversation well-nigh impossible. The snakes rattle only when coiled up with the tail-tip standing up erect in the centre; whilst gliding away they are mute. There cannot be the slightest doubt that the rattle acts most efficiently as a warning, and is now intentionally used for this purpose. It is not man only that takes notice of it; horses and dogs are most susceptible, and according to the natives so also are stags. . . . The best rattlers are most phlegmatic: they know their own strong points, but give fair warning to be let alone, in order to avoid accidents which might be regretted by both parties—aggressor and defender."[1]

Now, the ever-accumulating reports and definite statements of trained and expert

[1] *Through Southern Mexico*, Hans Gadow, M.A., Ph.D., F.R.S.

observers who have travelled extensively go to show that it is a very general rule that these poisonous or other more deadly powers are not used except to secure food, or in self-defence, when their owners are attacked or provoked. There are certain exceptions, though such can frequently be explained.

Also the animals native to any given district are instinctively and otherwise well acquainted with the poisonous nature of its plants and animals so protected. "Otherwise"—for young animals do not *always* at first fully trust their instinctive equipment! They *do*, at times, make experiments, with dire results which (if not fatal) are never forgotten. It is mostly when civilised men enter some foreign country, often ignorant of its nature and inhabitants, taking his dogs, horses, and other animals not native to that country, that one hears much of mortality or pain from this source.

CHAPTER V.

LATENT LIFE.

NO treatment of our general subject would be at all complete without some reference to the extraordinary phenomenon known as "Latent Life." It consists in the suspension of vital processes and activity for weeks, months, and even years, and the immediate or gradual resumption of such vital activities upon the return of favourable conditions. This persistence of vital power, under what we should certainly consider impossible conditions, with its subsequent re-flow, unimpaired and in full vigour, presents to our minds a new vision of Life, before which we can only bow in mystery and reverent awe, and reflect how limited, after all, is our knowledge of the mystic and inscrutable powers which Life may possess.

We are all familiar with the fact of the dormant life of most of the seeds of plants, and the fundamental identity of all living matter is suggested by the close analogy of the very similar condition passed through very commonly by the eggs, embryos, gemmules, etc., of animal organisms.

> "While a few seeds, such as those of Poplars, must germinate at once (i.e., in a few weeks) if they are to develop at all, this is not the way with the majority. For most there is a period of quiescence which for some may be experimentally shown to be imperative. That it is not purely adaptive to the inhospitable state of the earth, and the cold weather, is proved by the fact that some seeds will not germinate at once, even in propitious conditions, and that others wait over several years." [1]

As to the corresponding ova or embryos of animal forms, two typical instances must

[1] *The Biology of the Seasons*, Prof. J. A. Thomson.

suffice. Sponges, in tropical countries, are frequently exposed, during the dry season, to conditions of drought and hot sunshine, which are soon fatal. But the minute asexual gemmules previously released by the sponge, though they become entirely dried up, and are blown about freely by the wind, retain their vital power in a wonderful way. They have been kept in this desiccated or dried-up condition for two years without losing their powers of germination.

The encysted embryo Hydra, after separation from the parent form, soon settles down to a rest of some weeks, in a torpid and inactive condition. In this state it may become dried up, and blown about; and the wide distribution of many lower animal forms is largely secured by this condition of desiccation.

Though phenomena of this sort are frequently displayed among the fully-grown primitive forms of life, we shall naturally select examples for our present purpose from

among the creatures of a comparatively well-advanced development, and possessed of a definite nervous system.

The fact that the Rotifers (Plate III., 9) are microscopic in size does not in any way preclude their possession of such elaboration of design. In reality their development brings them into near relationship with some higher worms, and the larval forms of Echinoderms. A comparatively large pair of nervous ganglia are usually present, and the sexes are distinct.

Yet many species, such as the Common or "Wheel" Rotifer, we know to be susceptible of "desiccation" and "revival." When the water in which they live normally becomes dried up (as the tiny pools, which to them are as lakes, frequently do) and they are left exposed to drought and heat, they continue to exist

> "as mere mummified dust, specks which are blown about by the summer wind. You may dry and keep them for weeks,

> months, and even years thus dried. Yet if you add a drop of water and place them in it, the functions of life are renewed and resumed with vigour."[1]

In this dry, and of course, foodless condition they can resist the extreme temperatures of 36° to 40° F. of frost, and heat (in water) of 158° F. They can even resist deprivation of air under an ordinary air-pump.[2]

Incredible as it may seem, we are assured that species of "Thread-worms" or "Eel-worms" (ANGUILULLIDÆ) though aquatic,

> "may be kept dry without any discernible hint of life for fourteen years, and yet become vigorous again when put in water. At any time during the fourteen years this revivification may occur, but not in the fifteenth year."[3]

A very extraordinary instance is also provided by the "Water-bear" (*Macrobiotus*)

[1] Andrew Wilson, F.R.S.E.
[2] *Cambridge Natural History* (vol. ii.).
[3] Prof. J. A. Thomson.

(Plate III., 8). Though only some $\frac{1}{25}$th of an inch long, it is by no means one of the lowest forms of life. Its organisation has led to its being considered by some authorities a "poor relation" of the spiders. It has a fairly developed nervous system, blood-fluid with corpuscles, alimentary canal, stomach, and excretory orifice; eight legs with claws, teeth with limy tips, etc., and is probably one of the most universally distributed of all segmented creatures.

The greatly resistant powers of life in such an organism are described by Sir Herbert Maxwell, Bart., F.R.S. :—

> "Mr. James Murray, biologist with Sir Ernest Shackleton's Antarctic Expedition, sunk a shaft through fifteen feet of solid ice to the bottom of a coastal lake, and brought up swarms of Rotifers and Water-bears. Now this lake never thawed during the two summers the explorers spent there; it may have been frozen for years (and even centuries) during which these creatures had been embedded in a

temperature of 40° F. below zero, incapable of course of discharging any function of life. Yet no sooner were they brought to light and placed in water than the Rotifers began scooping in atoms of food, and they, as well as the minute Rhizapoda and the Water-bears set about at once the process of reproduction, either viviparously or through egg-laying. . . . Moisture is essential to their active existence, but if that fails the animal dries up into what appears to be a grain of sand. In this condition it may remain for years; but the vital spark is not extinct."

Water-bears were found feeding on mosses in these desolate regions, and though frozen hard, along with the moss, night and day some 350 out of 365 days in the year, thawed into life for a few midsummer hours. While resisting these extremes of cold, Water-bears, according to Pritchard, have been exposed to heat, in water, gradually increased to 216°, 252° F. and over, without destruction.

Is it conceivable that such creatures can be subjected to degrees of heat so extreme, and to degrees of frost equally so, resuming after such experiences their vital functions, and yet be capable of feeling pain? or that they can survive deprivation of what would seem to be almost every necessary condition of life, for such extended periods, and yet be sensible to suffering? Dare we say, either, that, confronted with such authentic revelations, a nervous organisation *must* imply the sense of pain, or that almost any apparently contradictory conditions of life may not exist beyond the dreams of our philosophies?

Cases of latent life are by no means uncommon. The pupal state of the Lepidoptera, and many other insects, is neither one of rest, latent life, nor hybernation. It is one of transfiguration. But practical entomologists are well aware of the marvellous instances of latent life which *may* occur in connection with the metamorphosis of some

moths. When the chrysalis lies through the winter, the new-born moth we may say "sleeps" for some time in a state of hybernation.

But under what we must suppose are unfavourable conditions, the emergence may be postponed, sometimes for years. The Privet-Hawk moth (Plate III., 16) has been known to remain in the chrysalis condition for three years, while Mr. John Sircow records the coming out of a moth after six years of incarceration.

Mr. Richard South, F.E.S., in his most useful volumes, *Moths of the British Isles*, also states that some of the Eggar Moths (Plate III., 15) sometimes lie within the chrysalis for two years or three, and "occasionally they have been known to emerge *seven years* after pupation."

CHAPTER VI.

THE VERTEBRATE ANIMALS.

IN the vertebrate animals we find not only a more highly advanced structure, but a new type of organisation. The typical Vertebrate has an inner bony skeleton, surrounded to the uttermost boundary of the skin by *living* tissues, through the substance of which countless nerve-threads ramify in every direction. These proceed from brain and main spinal cord, the latter securely protected within the line of vertebræ; the brain is now effectively protected by the bony skull.

For the present purpose, speaking in a very general sort of way, we may consider the higher vertebrate animals, like the various mammals, as conforming generally to this type of structure, so approximating

somewhat closely to that of our own bodies; and though this presents us with some new difficulties, it enables us to understand to some extent the experience of creatures struck down and mangled by some powerful predatory enemy.

The fact of our being able now to speak far more definitely of a "motor" and "sensory" nervous system is itself significant. It seems natural to conclude that a highly developed sensory nervous equipment must result in a much greater capacity for the experience of pain, and this is true, within certain well-defined limits: but I hope to show that this very higher and more elaborate development of the sensory nervous system may operate in causing unconscious conditions when higher animals are exposed to deadly conflict or attack.

It is, of course, beyond question that a capacity to feel pain, less or greater in degree, is present in these higher animals, and it is soon realised that it may now serve

useful and important purposes. As a guard against incurring wounds and injuries which, though of no great extent perhaps, may become fatal through loss of blood, etc., or cause crippling of the active movements; and particularly as a final incentive to vigorous and supreme effort to escape from adverse conditions which, in these creatures endowed with larger and freer powers and independence, *may be so overcome*, transitory experiences of pain may be not only useful, but necessary.

Let us look at some statements made by those specially qualified to judge.

Henry Drummond writes :—

> "While it is essential to an understanding of the course of evolution to retain in the imagination a vivid sense of the struggle for life itself, we must beware of over-colouring the representation, or flooding it with accompaniments of emotion borrowed from our own sensations. . . . Especially must we beware of reading

into it our own personal ideas with regard to accompaniments of pain."[1]

In the pages noted at foot Drummond has dealt in his usual vigorous way with the question of struggle and pain, but one feels that if he had had the reports of later research and evidence before him he would have had something stronger and more definite to say.

Wallace, who had a far greater practical experience, does speak with much greater decision. "The supposed 'torments' and 'miseries' of animals," he declares, "have little real existence, but are the reflections of the imagined sensations of cultivated men and women in similar circumstances, and the amount of actual suffering caused by the struggle for existence among animals is altogether insignificant."

And in his latest book,[2] after alluding to

[1] *Ascent of Man.* See pages 241–274

[2] *The World of Life*, 1910.

some of the elaborate weapons developed for predatory purposes, he states :—

> "The idea that all these weapons exist for the *purpose* of shedding blood or giving pain is wholly illusory. As a matter of fact, their effect is wholly beneficent even to the sufferer, inasmuch as they tend to the *diminution* of pain. Their actual purpose is always to prevent the escape of captured food—of a wounded animal, which would then, indeed, suffer useless pain, since it would certainly very soon be captured again, and be devoured." (Plate III., 18, 19, 20, 21, 22).

And, indeed, the universal sweep of that great central law of Nature—natural selection, with consequent survival of the fittest —as Darwin has it, "the vigorous, the healthy, and the happy"—is a fine example of that stern kindliness of Nature, the truth of which has been so pitifully emphasised by contrast, in our human organisations. Scientists, doctors, and philosophers have

uttered warning upon warning of the most serious danger to the race of our abnormal support and encouragement of the unfit, and it is obvious that a very large and ever-increasing part of human misery, disease (and consequent poverty), degradation, and insanity is due to our power to prevent the working out of this great beneficent law, without the substitution of other effective means to the same end.

How many wild creatures have you seen in a similarly helpless, diseased, and suffering state, where *man's* influence has not operated? Subtle, yet simple and sharp, are the methods of Nature to prevent or limit strictly anything of the sort. For instance, Mr. Francis Ward, F.Z.S., F.R.P.S., tells us that the most "silvery" of fish are almost invisible at a short distance, as seen as other predatory fish see them in the water, and he explains why. But a dying fish becomes unable to preserve a true balance, and as soon as it begins to lean

over to one side the light from the surface is reflected from its scales. This acts as a well understood flash signal to pikes, sharks, etc., that food is here easily obtainable, and the silvery one is despatched without delay.

Mr. Ernest Thompson Seton, a constant and able observer of wild life in the open, whose writings are well known, "has protested again and again against the idea that has been expressed that the whole of the Creation is groaning in pain;" while Mr. Ed. Bartlett, F.Z.S., declares that "most of the creatures that are preyed upon belong to the more timid class, and when seized suddenly lose all power—in fact *faint*—and become unconscious, and consequently are saved from suffering pain, dying in a state of insensibility."

With regard to the attack of birds of prey—

> "In almost every case, indeed, an animal which is struck by one of the hawks is killed at the first blow, for the talons

not only tightly hold the body in their clutches, but penetrate through the flesh to the vital parts, and so cause a wound which is instantly fatal."[1]

There is one point in common respecting the action of the talons in Birds of Prey (Plate III., 18), and that of the claws of the "Cats," which intensifies their power of grip when an animal is seized. Strong pressure on the under surface of the foot, such as would be caused by the severe impact of swoop or spring, causes a mechanical tension (apart from the exertion of muscular force) on certain tendons, which results in the claws being exserted and driven down to their utmost capacity at the moment of seizure.

The force of such impact can be estimated from an incident witnessed by Mr. Oliver Pike and a naturalist friend. He states that a Sparrow-Hawk descended upon a chicken in a wire pen, as it supposed, having evi-

[1] Rev. Theodore Wood, F.E.S.

dently failed to notice the wire. The Hawk *was killed instantly* on striking the wire-netting, and made a dent which the observers failed to equal by throwing a large stone as high as possible, and letting it fall upon the wire.

Mr. Pike definitely states his belief that rabbits and birds are instantly killed by the terrific "force of impact" and seizure when secured by Kestrels, Sparrow-Hawks, and Eagles." Many years before the Rev. H. H. Higgins (Chairman of the Liverpool Museums Committee), had made an almost precisely similar statement. Some remarks upon the lower cold-blooded members of the vertebrate division will be found in Appendix B.

CHAPTER VII.

"DEATH-FEIGNING."

THE striking phenomenon which is usually referred to under the loose and general title of "Death-feigning" occurs in the life-history of a large number of living creatures — Crustaceans, Spiders, Insects, Birds, and Mammals. The condition itself, and its great range through such widely separated classes of animals, certainly seems to throw some light upon the problem.

Take, for instance, the behaviour of many beetles. A large beetle in its clumsy evening flight happens to strike an obstacle—or, in many cases, it may suffice that it is merely touched as it crawls. The result often is that it falls instantly into a state which has all the outward appearance of death. For a

time it lies with legs drawn up, the whole body rigid and motionless. It may be handled or rolled about in this state without displaying any signs of life. I was standing one day on a garden path when a pair of Magpie Moths, absorbed in chase, flew directly toward my face, when I put up my hand, and with quite a gentle movement warded them off. To my surprise both insects fell directly to the ground, and lay absolutely still, just as they had fallen. They were so convincingly "dead" that I did not even think of the possibility of "death-feigning" for some time.

I lifted one moth and examined it closely for a moment, during which it still remained as convincingly "dead"; then lifting both I took them inside and laid them on the table, going into another room for a moment. When I returned the moths were flying about the room, and seemed quite unaffected by such experience. This "death-trance" lasted about two minutes.

The liability to fall into a state of this nature seems not at all uncommon among the invertebrate animals, and even in them, appears curiously suggestive of a person "going off in a faint!" Whatever such a state in the higher animals may imply, in these lower creatures it seems to me foolish to speak of "feigning," "shamming," or "acting." For one thing the condition is often caused by *any* sudden shock (I have seen a Dor beetle walking along a bank lose its balance, roll down a few inches and be thrown into this state); for another, their nervous organisation and low state of consciousness would seem to make such a view highly improbable: it appears much more like the operation of unconscious and reflex action in such cases.

In insects this seems to be at least a life-saving device; there are many insectivorous creatures which will only seize prey that they see in motion. We may be convinced such insects cannot experience *pain* in any

case, yet this condition seems to point to an effect on the whole organism which, in other and higher developments, we may have cause to feel constitutes, especially as regards the highest animals, a really merciful provision—a sort of anæsthetic automatically administered at the approach of death by attack.

Prof. J. A. Thomson speaks of this as "a state allied to hypnotic trance"; Mr. W. H. Hudson believes that it is probably due to temporary paralysis, occasioned by sudden concussion.

In the case of "death-feigning" by birds like the Canadian Ruffled Grouse, Wryneck, Kingfisher, Humming-birds and others, and animals like the Opossum (Fig. 24), Dingo, and Argentine Fox, the temporary paralysis caused by a violent nervous shock, appears to be utilised, in a further *conscious* deception, as such original physical effects wear off, for life-saving purposes.

Mr. Headley writes—

> "We must not put this behaviour down entirely to good acting. The animal is actually afraid, often even paralysed by fear. In time it recovers itself, and seizes any opportunity to escape that offers. But the natural stimulating effects of fear have been turned to account, and the temporary paralysis caused originally by a violent shock to the nerves has by long ages of selection been developed and improved, so that now we may look upon it as due to a valuable protective instinct, though helped in many cases, if not all, by actual alarm. It is very remarkable that this instinct should be found in creatures so remotely connected as Spiders, Beetles, Birds and Mammals, and in birds in species belonging to widely different families, *e.g.*, the Reed-Bunting and Canadian Ruffled Grouse."[1]

Indeed, we are well acquainted with a state of paralysis or partial paralysis among human beings, brought on by severe, and

[1] *Structure and Life of Birds*, F. W. Headley, M.A., F.Z.S.

usually sudden, shock; seizures not infrequently also removed by a later succeeding shock.

That such creatures are actually unconscious of pain during the earlier stages of this death-trance seems fairly evident.

Referring to the Argentine Fox, Mr. Hudson says—

> "The fox fights fiercely at first, and then dies. So well is this acted that dogs are quite deceived. The Guachos, who are a very cruel race, sometimes torture a fox in this state. Yet he is not roused. . . . Probably, though not insensible, it has yet its body thrown into that benumbed condition which simulates death, during which it is unable to feel such torture."[1]

Again, we are informed that the Dingo, of Australia, feigns death "with such persistence that an individual has been known to be partly flayed alive before moving."[2]

[1] *The Naturalist in La Plata*, W. H. Hudson, C.M.Z.S.

[2] **F. E. Beddard, M.A., F.Z.S., F.R.S.C.**

Well, I for one do not believe that such animals *could*, simply as a result of will power, remain motionless, and steadily "act" a part, or "sham," exposed to such terrible conditions; but Mr. Beddard's statement falls into line if Mr. Hudson's view as to unconsciousness to pain is correct, as it certainly appears to be. It is curious that Mr. Hudson should use the words "though not insensible," in view of what will appear, in connection with human experience, in chapter ix.

I have already quoted Mr. Ed. Barlett's statement that "most of the creatures that are preyed upon belong to the more timid class, and when seized suddenly lose all power—in fact, faint—and become unconscious." But what is "fainting"?

In human beings "fainting" is frequently brought on "by a violent shock to the nerves." In any case a glance at what usually takes place when people fall into this extraordinary state (familiarity has, as

Fig. 24.—Virginian Opossum.

usual, bred contempt as far as our wonder is concerned) is very instructive.

"Fainting" results from sudden anæmia, or bloodlessness of the brain, the blood being swiftly withdrawn from the brain to the heart. There is an immediate cessation of *all* functions, including even those that work by reflex action. The heart stops beating at once, and respiration ceases. *There is* a sense in which we might now say that the person is *dead*: and certainly the person affected has all the appearance of being so.

But there is a normal restoration of circulation after about two minutes, in all ordinary cases. Indeed, the heart may resume its activity after a stoppage of three minutes, and consciousness gradually returns. During this state the person is of course entirely unconscious, and incapable of feeling pain, or any other sensation.

How far the conditions of death-feigning conform to this state, we do not know; but

there is nothing essentially to prevent higher animals from being subject to the same influence. Is it possible, that in this last death-faint *restoration* does not occur?

CHAPTER VIII.

HYBERNATION AND ÆSTIVATION.

THE state of Hybernation also is of deep interest and suggestion, and has an indirect bearing upon the problem. Once familiar with the word, and the fact that both plants and animals, in colder climates, mostly fall into such a state, it is too readily assumed that the popular application of the term "sleep" or "Winter Sleep," is really descriptive or accurate.

This is *not* "sleep," but a condition very different in almost all its characteristics, except that it is also one of unconsciousness; indeed, it resembles in many ways rather the state of Latent Life.

A truly hybernating animal, in this condition, is profoundly unconscious and remains so for months—it may be for six months.

Now during sleep (itself a condition that is still largely a mystery!) respiration is carried on even more fully than usual, and all the fundamental physical functions proceed freely, carried on by reflex action.

But in the state of Hybernation respiration is almost entirely suspended; it is difficult in some instances to imagine how it can continue at all! Frogs and fish are not infrequently found entirely embedded in solid ice, and a Pike-like fish of Alaska *(Dallia pectoralis)* appears to be quite accustomed to incarceration in this way for long periods in winter, yet if thawed out gradually resumes its activity, and seems uninjured in any way. Fish of many kinds like the "Serpent-heads" are, each dry season, dug out of the solid hard-baked clay which, in its normal condition, formed the bottom of the water-tanks, beside some river in India. In periods of drought these "ponds" dry up, and in the fierce sun the clay becomes almost as hard as a brick.

Though the Serpent-heads like many of the "Walking fishes," have accessory breathing organs in the head, which, while they remain moist, make the fish able to leave the water and travel short distances overland, these can hardly continue in operation when all is parched up, even if we suppose an air-passage through the clay.

"During the time they are buried in hard mud, it must be assumed that these fish become entirely torpid and *stop* the respiratory function!" On being placed in water, fish dug out of the clay in this way, soon revive. This, of course, is a case of Æstivation. The African Lung-fish *(Protopterus)* furnishes a somewhat similar instance. But a definite "burrow" is made by this species before the clay hardens, with air-funnel to exterior. As is well known, this Lung-fish breathes by "lungs" as well as gills. (See Fig. 25, A.B.)

Many tests and experiments of some value were made many years ago, by Dr.

Marshall Hall, with animals in the hybernating state, which seem little known. Bats, in true hybernation, "have been gently immersed in water, kept carefully at the same temperature as that of their bodies, and have been sunk below the surface for sixteen minutes and found to be none the worse for the bath. A Hedgehog has been subjected to the same test for twenty minutes, and although it moved slightly under water, and expelled a little air from its lungs, it was not at all injured by the experiment." Hybernating Butterflies may be immersed in Carbonic di-oxide (the Rev. Theo. Wood, F.E.S., declares for twenty-four hours!) and be no worse. All this applies only as long as the creatures are not roused or "wakened."

The torpid condition into which the internal organs fall, is also very puzzling. If the heart does not entirely cease to beat, its action is reduced to almost nothing. Mr. W. P. Pycraft, A.L.S., F.Z.S., asserts that

"the circulation is *suspended*, and the heart *ceases to beat*" in the case of Amphibians! in fact, with respiration almost in suspension, it is difficult to see how the blood could be renewed and vitalised, or waste disposed of, seeing there is also no excretion. The activity of all internal organs slows down in the same sort of way.

Again, the temperature of the body (doubtless as a result of all this) falls practically to that of the surrounding air, and "warm-blooded" animals, like hedgehogs and bats, become as "cold-blooded" as amphibia or reptiles in this state. The temperature of the surface of the body may be a degree higher than that of the air, and Dr. Jenner found that the internal temperature of a hedgehog was 3° F. higher—as did Dr. Hall. Suppose we take the normal temperature of a bat, in the active state, as 89° F., and that in the hybernating state it may fall to somewhere about 40° F., we have a drop of 49°!

But the condition of hybernation is not simply or mainly, if at all, a result of cold, as much evidence proves. It is possible that it may have been so originally. Professor Thomson believes that it now happens according to an established law of periodicity, cold in some cases as it were "pulling the trigger." All hybernating creatures seek out some more or less sheltered retreat; if suddenly exposed to hard frost the animal is first roused up, and then killed. Under particularly severe natural conditions also the state of hybernation may pass into that of death; indeed, it almost seems as if creatures sunk in hybernation are not far from the kingdom of death.

And yet, in spite of all this, a bat, for instance, is easily roused from the swoon, and resumes its active state, its temperature rising at the rate of some 20° F. per minute. Left alone, it will soon relapse again, but if the atmosphere is very cold, in this awakened state, it will die. Many hyber-

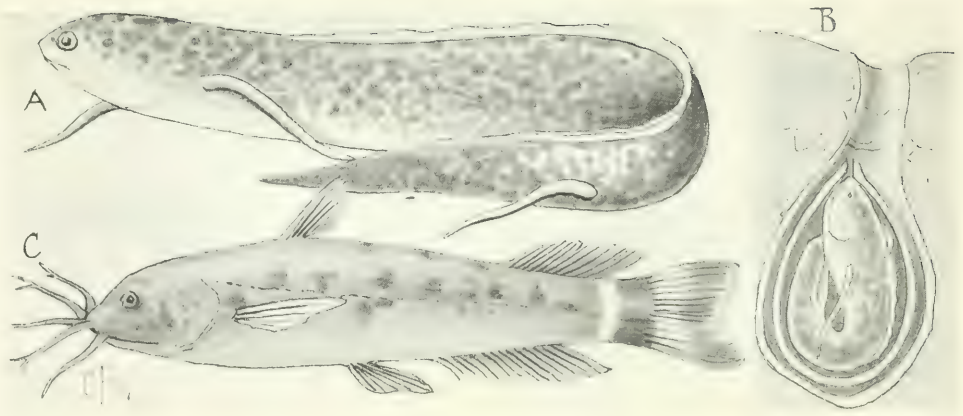


Fig. 25.

A. African Lung-fish (PROTOPTERUS). B. African Lung-fish (in Æstivation).
C. Electric Cat-fish of Nile.

nating insects and their pupæ may, however, be frozen till they are almost as brittle as glass, yet revive in due course.

Of course, no food or drink is taken at all; as, however, at least some of these hybernating creatures fatten themselves up previous to this time, it is just possible there may be a slow—a *very* slow—consumption of such stores internally.

Æstivation is the name given by naturalists to the practically similar state into which many creatures of various types fall in more tropical parts of the world as the "Dry Season" comes on—frequently one of great heat as well as drought.

The great purpose of this hybernating state, and the similar and extensively operating one of æstivation, is to preserve the *life* of the species under conditions which would certainly entail starvation otherwise, as the natural food is not then procurable: but we cannot and ought not to overlook the fact

that these conditions are both conditions of *entire unconsciousness.*

Now let us gather up some of our threads. Are we not, at least, becoming familiar with *frequent states of unconsciousness, in face of special crises* in the lives of animals, in which we must believe it is impossible, or highly improbable, that pain can be felt?

The effects of the rigour and scarcity of food-substances resulting from the Northern Winters, are avoided by Nature's Children in varied ways. The natural term of life in most insects, and many of the more lowly creatures, seems to end before or by the approach of winter; the life of the species being carried forward by the eggs, hybernating larvæ, or adult females. Green leaf and honeyed flower have withered and fallen; the problem of winter supplies is solved now by natural *death.* This vast decrease in insect life, and the inactivity of the remnant in hiding, means the loss of food supplies for insectivorous birds, amphibians, reptiles and

mammals. There are no hybernating birds. Here the solution in general is *Migration.* Some species, resident with us all the year round, have adopted a more or less omnivorous diet, and this comparatively small number can usually tide over the bare and cold season. All amphibians and reptiles, along with many mammals—dormice, squirrels, field-mice (partially) and bats, badgers and hedgehogs (for long periods), and others —solve the problem by *Hybernation.* So Nature decrees—kindly enough!

CHAPTER IX.

THE ARGUMENT FROM HUMAN EXPERIENCE.

AFTER what has been advanced in the previous chapters, we are now in a much better position to estimate, even along natural lines, what measure of truth may be usually expressed in the suggestion that, under truly natural conditions, death comes to the victims of predatory attack unaccompanied by the experience of pain—often when in a state of complete unconsciousness.

Those who have watched a domestic cat "playing" with a mouse it has caught must have noticed that the latter seems at first insensible, and then in a state of stupor apparently still unconscious of the work of the cat's teeth and claws. After a time

consciousness seems to return partially, and the mouse attempts to run, but in a very ineffectual, drugged sort of way. Such an observer will notice also that the cat gives its sleek victim many vigorous shakes.

But we must not suppose that pussy's behaviour in this is at all representative of that of her tribe. This "play" is unnatural. The "Cats" in their natural state, however fiercely active at times, are on the whole decidedly lazy, and seldom hunt and attack unless stimulated by hunger, in which case there is a swift procedure to "business." The domestic cat, if fairly well cared for, is very seldom *hungry.*

Still, in an instance of this sort, we have been enabled to note for ourselves the state of stupor induced by the cat's seizure, and this is of some importance in view of what will be said in the present chapter.

Have we any more direct evidence by which we may estimate the experiences of such a mouse, or other mammal, when seized

and mangled in what to them is usually the first and last attack of some beast of prey?

The very method of attack by some of the great "Cats" must ensure almost instant unconsciousness of the victim.

> "With very few exceptions, the Tiger breaks the neck of every animal it kills."[1]
>
> "The footsteps of the Puma were to be seen almost everywhere on the banks of the river; and the remains of several Guanacos (Wild Llamas) *with their necks dislocated* and bones broken showed how they had met their death."[2]

This swift and certain administration of the final *coup de grace* is not at all uncommon; we have seen it even among the Invertebrates. The Tarantula Spider secures the instant death of its insect prey, such as bees, "with unerring precision and lightning rapidity plunging its fangs *into the vital spot.*"[3]

[1] Sir Samuel W. Baker, F.R.S., F.R.G.S., etc.
[2] Darwin, *Voyages.* [3] *Spiders*, Cecil Warburton, M.A.

Even if pain *is* experienced at all by the higher animals (Mammals) in the final death-struggle, human experience would tend to prove that it can be of no great intensity. For even within the boundaries of the human race, those who read much of modern books of travel, by competent and trained authorities—naturalists, anthropologists, medical doctors, etc., like Dr. H. O. Forbes, Sir Harry Johnston and Sir Frederick Treves—are aware that there is a mass of cumulative evidence now available, proving that in the case of such "savage" peoples as the Hottentots, Negroes, Maories, etc., pain is certainly not felt with anything like the same intensity as it is in the case of the civilised, sensitive, nervous "white man." The comparative indifference when wounded or injured in ways *we* should call serious, exhibited by such natives is often striking; even the calm endurance of extensive and prolonged flesh-cutting and tattooing, as performed in the native way, would, we

believe, be quite impossible in the civilised white woman—however great a slave to "Fashion"!

Now in view of the close approximation of the general organisation of the higher warm-blooded animals to that of our own, if we could obtain an actual body of evidence (apart from merely exceptional cases), of the sensations and experiences of men and women who have been attacked, wounded, and mangled by such beasts of prey as Lions, Tigers, Leopards, Jaguars, Bears, etc., surely we may have reason to suppose that such animal victims (*they* are not "rescued") that fall to the power of each carnivorous and powerful creatures, may be similarly affected under the same conditions?

Fortunately we have such a body of evidence at hand, thanks largely to the careful efforts of Mr. J. Crowther Hirst, who has collected a considerable number of reports of such human experience. Many were received directly from those who passed

through such experience; the remainder from strictly trustworthy sources, such as the statements of medical doctors and missionaries of what has been declared by those whom they have tended in hospitals, etc., who had been rescued after having been attacked and mostly severely wounded by lions, tigers, bears, etc.

The case of Dr. Livingstone was already pretty widely familiar. The doctor described his own experience clearly in his *Missionary Travels*, and states very definitely that he felt *no pain*, or any sense of fear at the time. Yet he was conscious of what was going on around him! The lion, he tells us, gave him several vigorous shakes, and he was badly mauled, the bone of one arm being broken. From Mr. Hirst's little book we can quote only the two following statements—

> "The Rev. E. C. Johnson, until recently a missionary in Lahore, lost an arm many years ago in consequence of an encounter

with a large Bengal tiger. . . . The wounded arm was badly broken, so badly, indeed, that amputation was necessary. Yet Mr. Johnson states 'that there was *no pain* beyond feeling my arm in a vice.'"

Ernest T. Neve, M.D., F.R.C.S., in charge, with his brother, of the Church Missionary Society's Hospital, in Prinagar, Kashmir, gives evidence as follows—

"Every year we have about half-a-dozen patients who have been mauled by bears. In every case in which I have inquired, numbering probably over twenty, there was *no pain* while the attack was in progress. There appears to be a calm and almost analytical frame of mind—a wondering what the bear is going to do next."

Some variant of the declaration "I felt no pain whatever, and no fear," is conspicuous in the evidence given in sixty-four cases out of sixty-six, and Mr. Hirst's book,[1] giving so frequently the actual words

[1] *Is Nature Cruel?* by J. Crowther Hirst (Jas. Clarke & Co.).

of those who have been seriously mauled and injured by wild beasts, should be carefully read, and will be found very convincing.

Like Dr. Livingstone, most of the victims of attack mentioned by Mr. Hirst seem to have been quite aware of what was going on around them, and this rules out such cases from being included amongst those of fainting.

One of the most detailed accounts I have seen, is not included in the book mentioned. It is given by Mr. Ernest Brockman, a telegraph constructor in the service of the British South African Company, in Rhodesia.

So terribly mangled by a lion was this poor fellow, that it was almost a miracle that he survived. Yet these words occur in the narrative—

> "I thought how curious it was that I should be lying there *without the slightest sense of pain*, with a man-eating lion chewing my flesh, and drinking my blood. I *could* not realise the full horror of the

thing. . . . I could distinctly feel each bite, because, though it caused not the slightest pain, yet, as the fearful fangs were driven into a fresh place in my thighs—the monster only chose the more fleshy parts—I was conscious of a particular numbness in that part."

Stronger evidence of human experience of this kind we could not expect to get. After all, we cannot forget that man takes his place, *sui generis*, on *one* side of his nature, as the supreme animal—the highest mammal. Yet is he also far more; he is, even in this matter, Nature's Interpreter and Voice.

CHAPTER X.

THE ARGUMENT FROM HUMAN EXPERIENCE

(*Continued*).

IS there, then, something peculiar and unique in the state of insensibility to pain and fear caused in human beings by the attack of these ferocious and much-dreaded beasts of prey?

We need not suppose so: it seems much more probable that such seizure operates as perhaps one of the most effective causes in the production of a state of such insensibility which may also be caused by other sudden life and death crises, and it is to this point I shall now particularly refer.

How terribly a highly developed and elaborated nervous system *can* become the means by which pain of a fearful and severe

kind is felt we know only too well by our own experiences. But reflection soon shows that the intensity of human suffering is, or has been, mainly the inevitable result of Man's supreme contempt of Nature's teaching, and his insolent repudiation and defiance of her changeless laws. It is not usually a matter to-day so much of the individuals who actually suffer; rather the criminal deflection, in our present machine-driven civilisation, of the fruit of our scientific knowledge to the benefit of the rich, and to purposes of destruction and death, rather than of general health and life!

But with this greater *possibility* of suffering which all higher nervous organisation may mean in men or animals, it appears to me there is linked the merciful provision that in final and inevitable crises which may or must mean death, such an elaborate balance and adjustment may be thrown quite out of gear by powerful and sudden shock, and in a very large measure become inoperative.

For instance, it is well known that when in a state of intense excitement men are often unconscious of pain or fear. Many cases are on record of soldiers being severely wounded in action who, during the actual stress of the struggle, have not been conscious that they were injured. Men who fall and die in such a state, we can hardly doubt, die a painless death.

Evidence of this sort has been advanced during the progress of the unspeakable "world-war" which is devastating the earth at this moment. From one report I cull the following:—

> "I asked him how it felt to be wounded. . . . My Highlander said it did not hurt him at all at the time. He was standing up when it happened—he said it as though he had been standing up and stretching himself—and something knocked him down, a regular knock-out blow, but it did not hurt, and at first he could not make out what had happened until he saw that he was bleeding. Then, and not till then,

> he felt pain—a sharp rheumaticky pain—and began to feel weak and sick, and finally collapsed. I have since spoken to several other wounded men, and in each case they seem to have felt very little pain at the moment of the actual wounding, but very much more when they were afterwards being cared for. . . . Perhaps the shock for a moment *puts the nervous system out of action*; perhaps the excitement of battle overcomes all other sensations."

Speaking generally of animals, Wallace also states that—

> "The absence of pain is not peculiar to those seized by wild beasts, but is equally produced by *any* accident which causes a general shock to the system."

And in this connection he refers to the experience of Whymper, the well-known mountaineer, who once fell several hundred feet on the Matterhorn, rebounding from rock to rock in his descent—

Fig. 26. Redwing.

"He declares that while falling, and feeling blow after blow, he neither lost consciousness nor suffered pain, merely thinking calmly that a few more blows would finish him."

The following incident also serves to show that experience of this sort is, or may be, fairly universal :—

"When Santos-Dumont, as he tells us in that singularly interesting book, *My Airships*, was face to face with what seemed certain death—his airship doubling up till he thought the ropes must snap and let him fall from that fearful height—he felt no fear whatever, wonder only. 'What or whom shall I see after death?' In such moments there is no room either for regret or terror."

Once more, it is a well-known fact that men exposed to intense cold, and unable to maintain vigorous action, quickly fall into a pleasant stupor and sleep, when, if not dis-

turbed, death follows which is certainly painless.

We have reason to believe that it is much the same with birds like the Redwing (Fig. 26) and other thrushes, etc., which are sometimes found dead in numbers during a severe course of frost. At such times there is great difficulty in securing food (the Redwing is mainly insectivorous); and birds require a comparatively great amount of food to sustain their energy and general high temperature. Thus the intense cold, in the presence of so little to sustain heat, may kill very quickly; but we may more truly say that the bird dies of cold, rather than through starvation.

In the face of all these facts of human experience (and I could add many more), surely we may see the working of a stern but merciful Providence. It matters little *how* such a condition is brought about, in which neither pain nor fear is felt; but it matters infinitely that it *is* brought about.

CHAPTER XI.

CONCLUSIONS.

IN a problem of this kind it is difficult—when possible at all—to bring forward mathematical "proof" or positive demonstration: and perhaps this is why Science, as such, has made so little systematic enquiry into the subject. But, after all, valuable and indeed priceless as is the "scientific method" in its place, it is not the one and only means by which we may form reasonable and true conclusions and convictions. The highest and supremest truths are, in very large measure, above and beyond "mathematical proof" or "scientific demonstration."

We appear to have fallen, in this mechanical and materialistic age, into the error of supposing that reason alone can deal with

and comprehend all Truth, and that no truth really exists which mere reason cannot adequately understand and encompass. The grasp of the hand of Science may be pretty sure, but it is limited (as yet) in its reach, as its highest advocates admit; and, naturally and rightly it has gathered *facts*, as its foremost duty.

But, in the case of our present problem, and in many others, it is the *interpretation of the facts* which is of most importance to the vast majority of men and women. It is here, in the broad interpretation, that Science alone has so often failed us—it is not difficult to see why. Reason is one of our most trusty guides in life, but it is *not* the only true guide, as is indeed evident in our decisions and course of action almost daily. Instinct and feeling are not necessarily useless, untrustworthy, or misleading; while it is often through the power of Imagination—the "seeing" power of "insight" and "vision," when the whole gathered faculties of a man

combine to present the revelation (in which, of course, reason and knowledge have large part), that unproveable but eternal truth is apprehended, and a definite personal conviction established.

How far such high human powers survive to-day is a question one sometimes hardly dares to consider. The ever increasing spread of the anti-natural, anti-human, and anti-divine environment always created by an avaricious machine-driving and machine-*driven* type of "civilisation" has for centuries been producing (the laws of Nature being inexorable) its "fittest!" in physique, thought, and spirit. What "fitness" to *such* an environment is inevitable is only too obvious to those with open eyes and more unprejudiced minds, in theory and fact! and in that atmosphere the atrophy of the highest and noblest faculties and powers of the human spirit is equally certain. They are now "detrimental"—increasingly fatal to "success." The "fittest" lift up their eyes and

say, "Behold, this dreamer cometh," and *sell* him, if possible, into slavery!

The vision of Evolution—the master-key in interpretation of Nature and Life—has, when adequately realised, unlocked many a door in the Natural World. Wallace has laid great stress upon the evolutionary argument in relation to the question of pain in Nature, contending that capacity for pain is virtually absent in most, if not all, Invertebrates, because in their case such experience would serve no necessary purpose; and, of course, if useless, could not but be seriously detrimental. I have not done more than merely touch this view, as its real force will scarcely be felt by any who have not given some serious consideration to the study of evolution.

But thoughtful men and women generally cannot escape from the mental and moral difficulty presented to their minds, if creatures which possess no power of moral choice, and which are wholly controlled by natural

law, are believed to suffer pain, as we know it, especially when in due time they must contribute, by their own death, to the general food-supply of the world. This is part of their appointed destiny, and of course is infinitely preferable to a slow death by disease or helplessness.

The simple fact is, that we must *all* have *some* opinion, conception, or conviction about this matter; and most men who give to it any thought can scarcely help feeling that if such sentient creatures live out their lives, and fulfil their purpose faithfully, there *is* something intrinsically unjust aud essentially cruel, if they really suffer pain in doing so. An unbalanced conception of this sort cannot but strike radically at the very foundations of all true moral and religious thought.

I have attempted to present an elementary but reasonable review of such facts, and such opinions of experts, as bear upon the problem, or appear to do so: my hope in doing so being to bring forward a perhaps new

point of view to many readers, which may be helpful, and enable some—if their outlook has been of a pessimistic order (and so itself surely painful and retardative)—to readjust their thought.

The whole subject of the reflex action of the nervous systems seems to me most suggestive in connection with this problem. Does it now seem reasonable to suppose that in those countless living creatures *which have no brain*, there can be a consciousness of pain? And if to this reflex action is committed the control of such important functions and activities as we know to be the case in our own bodies, there is little doubt but that such action would be itself sufficient, if in fact not in many ways preferable, in controlling the actions of the lower animals.

This may become clearer if we consider for a moment the vastly different nature of the sensory organs we call eyes. The Common Scallop is provided with a number of

"eye-spots" or "ocelli"—eyes which seem to be sufficiently sensitive to varying degrees of light, and the casting of a shadow in particular, to give the creature a chance to leap backwards into safety. But the Scallop has no brain, or even head! and the elementary eye-organs, as in Invertebrates generally, are formed from the *skin*. They can hardly be sensitive to touch, as they must frequently be in contact with sand; if damaged, such organs can, as a rule, be reproduced by the skin, as is the case in snails.

But the highly evolved, delicate, and intricate organ we see in the eye of a bird or mammal is something very different. Its essential parts are now an outgrowth of the *brain;* the optic nerves are connected directly with the brain; and just in proportion to the delicacy, refinement, and elaboration of the instrument is its liability to injury—and even minor injury may become fatal to its efficiency. So we find it particularly sensitive to pain, for there is no regeneration

of an elaborate organ of this sort possible ; any serious injury means blindness, and blindness means, most probably, speedy capture and death.

Those whose thought is of the more unimaginative type may be inclined to dispute the validity of the argument from human experience, brought forward in the case of the higher animals. Do they realise at all the marvellous identity of the nature even of protoplasm, as such, whether of plant, invertebrate, or vertebrate animal, or man himself ?

In his presidential address to the members of the British Association, Sir James Lister spoke as follows :—

> " Anæsthetics have thrown light upon Biology generally. It has been found they exert their soporific influence not only on Vertebrates, but on animals so remote in structure from Man as bees or other insects. Even the functions of vegetables are suspended by their agency. They thus afford

strong confirmation of the great generalisation that Living Matter is of the same essential nature wherever it is met with on this planet, whether in the animal or vegetable kingdom."

The wonderful revelations lately presented by Prof. J. C. Bose, showing the almost "human" responses made by plants when subjected to the influence of anæsthetics, alcohol, and various poisons, carry this conception much further. As I have already stated, nervous response to stimuli is an inherent property of *all* living matter; and there is now no doubt that such living matter itself is affected in essentially similar ways, under certain influences, as that of our own bodies.

The subject has been involved in an atmosphere of needless perplexity by the irresponsible and merely sentimental "teaching" of many poets and writers. Rubbish like that of the following lines is freely

accepted and believed—lines resulting from sheer ignorance of facts :—

> "The poor beetle that we tread upon,
> In corporal sufferance finds a pang as great
> As when a giant dies";

while little enough general attention is given to the more faithful and accurate reflections on Nature's truths embodied in the work of really great poets like Tennyson, Wordsworth, and Robert Browning : the first often reflecting the pessimistic outlook of his day, the two latter, the larger and truer optimism of the deeper insight.

Finally, when nearly thirty years ago I began to reflect definitely upon the subject of Pain in the Animal World, the outlook appeared as dark as it could well be. I felt quite unable to confute the terrible indictments of Mill and others. But a more or less steady and continued study of Plant and Animal Life, with this problem always kept in sight, since that time, has wrought in me firm conviction that Nature is *not* careless

or indifferent as to the sufferings of her children; that frequent provisions to safeguard them from all unnecessary pain and suffering are more and more to be traced; that there exists *no* useless pain among animals; and that where the consciousness of pain *is* experienced among the more highly advanced animals, it is never in such degree as that we are sadly familiar with in human life, and exists *only* for the preservation of healthy, sound, and enjoyable life.

But let us make no mistake. The mercy and kindliness of Nature, often stern of aspect, is a *real* and practical thing; very different to the false, ineffectual, mocking, and often insulting, "charity" and advance of a keener "pity of sorrows" that still remains so cowardly and wedded to selfishness that it dare not even "demand" openly the straight and constant battle with the well-known causes of the larger part of human misery. The greater part of all human evil, agony, misery, destitution, and

despair *has been perfectly preventible*, apart from any Utopian ideas. I know there are a few outstanding facts which refuse apparently to fall into line with the belief I have stated; but in what realm of human thought and enquiry is it not so? I have seen so many difficulties in this line dissolved, to my own mind, by fuller and later knowledge, and a maturer power of meditation, that I am content to leave such cases, for the present, *in obscuro;* they have sometimes a way of solving themselves.

And though, speaking generally, appearances in Nature *do*, when viewed superficially and merely from the essentially human standpoint, often suggest the widespread existence of pain and distress, it seems to me that there are few spheres in which, to serious and persistent enquiry, appearances are found to be so deceptive to us. The Spirit of Nature is indeed mysterious, yet one feels increasingly as this great problem is faced and probed, it is not insoluble; and that

there is to-day, as I trust I have helped to show, a much wider basis of evidence, direct and indirect, than was obtainable even some few years ago, and such as may be unsuspected by many who, unable to undertake any considerable study for themselves, really desire to know what can be known concerning the Problem of Pain in Nature.

APPENDIX.

A. *Autotomy and pain.* — It does not seem a very reasonable proposition that such dismemberment is accompanied by pain. The line of least resistance is certainly that followed by animals, and it could be no inducement, at any rate, to resort to a *painful* expedient at the very approach of danger.

As this surrender of parts is common among Vertebrates of the lizard tribe, and especially as this power of throwing off considerable parts of the body has become utilised for actual purposes of reproduction (as in starfish, sea-cucumbers, and some marine worms), one *does* find it difficult to imagine that a *painful* process should, in so widespread a fashion, be utilised for reproductive purposes also. We have no reason or right to assume that the latter includes

any painful experience, with the *possible* exception of some higher placental Mammals, though of course it is popularly supposed to do so, again owing to our almost invariably attributing modern human experience to animals.

B. *Case of the "cold-blooded" Vertebrates.* —I should have made some remark upon the somewhat marked difference — as it appears to me—between these lower groups of Vertebrata and the remainder, in the matter of capacity for feeling pain.

The comparatively imperfect oxidisation of the blood in these earlier groups, which results in a low or varying temperature usually corresponding with that of the surroundings, or slightly above, certainly entails a duller and more sluggish form of life-energy than is found in the warm-blooded creatures. Frogs, and particularly toads, are frequently reported as largely insensible and indifferent, to every appearance, to what may be considered injury or mutilation. Reptiles, we have some reason to believe, are in similar case; that many lizards should *volun-*

tarily throw off the tail when seized by that member, helps to confirm this.

It appears to me (though, of course, one's personal opinion or conviction is not necessarily any "proof" or evidence to another) that the restriction of the full vital flow and capacity, resulting in the main from an advancing, but only so far, a partially completed system of aeration of the blood, must result in some degree in a more imperfect, or less advanced operation of nerve action or force. In the strange contrast afforded by the great vital force and energy of insects (invertebrates, of course), it should be remembered that these are very short-lived, and that it is evident that structure of that kind is incapable of any higher development. Lizards, crocodiles, etc., and especially tortoises, on the contrary, with their comparatively small expenditure of energy day by day, live long, often very long, lives. The vast majority of reptiles and amphibians also pass a considerable part of the year in a state of hybernation or æstivation.

Such considerations, together with such evidence as I have been able to come across,

gives me the impression that all such cold-blooded vertebrate animals possess little sensitiveness to pain—a position difficult to substantiate, I admit; for it rests upon the accumulated "proof" of many little indications which, taken alone, seem to have little weight.

The difficulty as regards fishes, is, of course, the uncertainty which still remains as to the actual function of the "pit-organs" and sensory organs of the lateral line, and head channels. The general nervous organisation of fishes is low, the brain of comparatively small size and efficiency, with a fairly well developed sense of sight, but little sense of smell, taste, or hearing.

There is no doubt fishes are readily sensitive to touch, and it is very probable that the organs of the head and lateral line along the body referred to are specially sensitive to the undulatory movements of the water, and each delicate degree, more or less, of pressure. Some authorities are of opinion they also convey chemical and electrical stimuli.

The only definite statement of belief I

remember coming across is that of Mr. W. J. Long, whose books on animal life are well known. "I have a reasonable conviction, based on some experience and observation, that trout do not suffer when hooked."

C.—The Rev. J. G. Wood, F.L.S., in his numerous writings, frequently asserted that bats, sunk deep in the hybernating condition, were very easily "wakened" by a sudden sound. Even a heavy step on the floor might arouse them, and that care must be used in this respect in experimenting with such torpid creatures. Now he himself states incidentally in one of his little books that he kept a bat in captivity for ten years. Not only so, but he certainly derived his knowledge of animal life in this country in far larger measure than most, from first-hand observation. He certainly also was a keen observer of facts; and one can hardly believe that in a matter of this sort he could be mistaken—especially as Dr. Hall's experiments were well known to him, and he was, I think, acquainted with Dr. Hall himself.

Yet I have been unable, throughout long

years, to discover either confirmation or denial of these assertions in any writings which deal at all with the subject of hybernation, or indeed to find any allusion at all made elsewhere to any such liability.

But if Mr. Wood's assertions are accepted, strange thoughts are apt to arise in one's mind—maybe merely suggested by coincidences, possibly having a deeper meaning.

It is well known that chemical action governs many processes (it would seem sometimes as if exclusively) in the complicated metabolism of animals. Biologists of wider outlook, however, realise that Life may alter the complexion of things, affecting even the very substance as well as action of living matter. All the same, the operation of actual physical and chemical reactions being so pronounced, one wonders if there is any natural relation between chemical action or combination caused by vibration—resulting from a report or sound of given rapidity of vibration, as actually occurs in the laboratory—and the effect of sound (vibration) on the mystic equilibrium secured and maintained in the body of a bat in

hybernation. In some digestive ferments of our own bodies the minutest trace of some chemical salt is absolutely necessary to their efficacy. I mention this only to show how great results in Nature often follow from what *we* think are quite inadequate causes.

I have been one of the few of the present generation who have had the opportunity of observing carefully certain photographs of the effects produced by Mrs. Watts-Hughes in her singular "Voice-figures," which were brought before members of the Royal Society by Professor Tyndall. The instrument used was quite simple, not unlike a small teapot, roughly, across the opening of which was stretched a thin membrane of elastic or other substance. Having covered the surface of this membrane with a light powder (usually Lycopodium) or some colloid substance, the lady proceeded to sing down the straight "spout" a steady sustained note of this or that pitch. She was an expert singer, with great practised control of the voice.

In the case of the colloid substances (semi-liquid), the matter in response to such sound or vibration disposed itself in such marvel-

lous forms upon the screen that one's constant impression is that these are photographs of *organic growth!* In a rapid survey they might be easily taken for photographs of seaweeds, liverworts, mosses, selaginella, ferns, and even *trees!*

The extraordinary thing is that, though not conforming to any of these in reality, the constant resort to dichotism, as well as the almost exact representation of the growth of the thallus, etc., so familiar to botanists, is at any rate very puzzling. To those who, like myself, have considered Le Bon's statements[1] as to the strange properties of colloidal metals, together with the still more marvellous revelations given in many modern text-books of Biology, as to the "mimic-cells" produced through the action of chemicals on colloidal substances, etc., the particulars I give may appear of peculiar interest, because of the part shown to be played by vibration.

What Paul meant, and how he conceived the thing, I do not in the least know. But

[1] *The Evolution of Matter.*

his words—"the *trumpet* shall *sound* and the dead shall *arise* incorruptible"—strike very strangely on the ear, in view of this line of thought.

We know that after death the body is dissolved, and its component chemical elements are separated, re-combined, and dispersed widely, through the action of several successive species of bacteria. We cannot, therefore, conceive a re-union of any such particles, and certainly there is no reason whatever to believe in the continuance of any material body after death. What *did* Paul mean?

Well, we have, shall we say—

1. Sound (vibration) — and an alleged restoration to "normal" life and activity (from a state, as I have already expressed it, not far from the Kingdom of Death), in hybernating bat.

2. Sound (vibration) and the creation thereby of a strange similitude of life-*growth* and form, in colloidal matter, itself so marvellously suggestive, in other ways, of organic, rather than chemical (inorganic) properties.

3. Sound (vibration)—and a declaration of final consequent restoration from death.

Is it merely coincidence?

D.—I will give one instance of this really merciful sort of provision, which appears on the surface almost as a case of "cruelty."

With the exception of some queens which hybernate through the winter, all members of our social wasp communities (unlike those of most bees and ants) live only through one season, their lives terminating naturally at the approach of winter.

But what of the carefully-tended larvæ and pupæ? Frost would certainly kill them —in time; but they are cosily hidden away within nest and cell, and would probably die a lingering death from starvation, after their nurses are dead.

But Nature will not have it so. The nurses themselves, as one of the last acts, kill immediately by one deadly thrust of the sting, each grub in the nest, and carry abroad their dead bodies.

Staveley naively says of this[1]—"By this expedient, an expedient second only to that found in the marvellous system of prey, a quick and easy death is substituted for one of slow privation and suffering, and the parents and nurses die the most enviable of deaths, having none to miss them, and no work unfinished."

Whether insects are capable of any true pain or not, such a case could *not* involve anything like "cruelty." For if they are not sensible of pain, the procedure becomes one merely of wasp economy: if they *are*, it must be regarded as truly merciful; for surely the reader would not wish it otherwise? But there is something so clean, swift, sanitary, and effectual in this "Finis" to one of Nature's annual pages, that it seems to commend itself fully to minds and hearts not enervated by a mawkish and impractical sentimentalism.

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[1] *British Insects.*

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